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MONTHLY REVIEW

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American Electroplaters Society

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Detroit Convention Items of Interest

The national convention of the American Electroplaters Society occurs at Detroit on July 8, 9, 10, and 11th. We want you to make your plans now, so that nothing can interfere with your presence at Detroit on those four days. It is a very central point and easy for everyone to reach. Railroad facilities include M. C., N. Y. C., Pennsylvania, Big Four, Wabash, and P. M. so that through service is provided from most large points.

However, our suggestion is that you get out the family flivver, or Pierce Arrow, as the case may be, tell your boss you will be back in two weeks, and bring along your family with the idea of attending the convention, and then going north to inspect the playground of America, northern Michigan, returning down through Wisconsin, or through Canada, depending upon your destination. Wide concrete roads stretch in every direction from Detroit, and motoring is a joy.

From the east, you can skirt the southern edge of the Great Lakes through Cleveland and Toledo, or you can cross at Buffalo, and pass along the northern side through Canada. From the South, the Dixie Highway runs straight up from Cincinnati. From the West, there are two excellent routes from Chicago.

We are going to try to make your stay, both for you and your family, as pleasant as possible. The headquarters will be the Statler Hotel, which is large, but also popular, so we would suggest that you write the hotel for reservations as early as possible. Other hotels in the immediate vicinity include the Book-Cadillac, Tuller, and Detroit-Leland.

Our tentative program of entertainment starts on Monday with

a theater party for the ladies at the Fisher Theater. This is certainly the most unique movie house in its decorations and effects in the country and is considered by many even handsomer than Roxy's in New York. We hope to be able to take you backstage, and as a result anticipate a flood of requests from the male contingent, but as there is an educational session that evening for them, they are not invited. The theater is located right in the center of the new Fisher Building, by all means the handsomest office building in the world, and a glance at the foyer is worth the whole trip.

On Tuesday the men are busy with educational sessions all day, but we plan a pleasant trip for the ladies around Belle Isle, culminating with lunch at the Yacht Club. Belle Isle is located right in the mouth of the Detroit River as it passes out of Lake St. Clair, and is entirely a city park, with natural wooded areas, winding lagoons and channels, and altogether picturesque. We know you will be delighted with both it and the Yacht Club which is situated on it.

Wednesday comes the first frolic for everyone. The men have a session in the morning. However, we suggest that the women folk, including the kids, do not wait for them, but go on to Bois Blanc, leaving them to follow in the afternoon. There are two morning boats on which your tickets will be good. The men leave at 1:30, and if the ladies are foolish enough to prefer to dance with their own husbands, instead of someone else, on the way down, they can wait for them.

Bois Blanc is an island in Canadian waters about 1½ hours down-stream from Detroit. It is beautiful and there is plenty to do. In addition to the planned entertainment such as the baseball game, etc., there is bathing, tennis, a fair golf course, dancing all afternoon, and the most wonderfully equipped playground for the kiddies that you have ever seen. There is only one drawback and that is that they never get a chance at any of the quantities of high swings, because they can never get their mothers out of them. You will have a good time, and your families will be missing a bet if they do not spend the entire day at the island, even if you cannot. We are providing one meal which you can eat whenever hungry throughout the day, without waiting for any specified time. The boats bring you back to Detroit about 8 o'clock.

Thursday we leave open for the ladies to recuperate from their

unwonted exercise of the previous day; let the beauty parlors get in their work in preparation for the banquet at night, or go shopping as they please.

After the business session in the morning, the men spend the afternoon visiting plants. We are only sorry we cannot take all of you everywhere, due to lack of time, as we have remarkable plating installations in this territory, but we are going to give you as broad a choice as possible, and allow each individual to pick the ones he prefers to see. In order to arrange transportation properly, we are asking you to make your choice at time of registration.

Thursday night we wind it up with the banquet, which we are trying to make a humdinger.

We want you, and we know that if you will show this to your boss at home, we will have you, so please don't cross us up, by not showing it to her.

Convention Com.

SOME FACTS ABOUT CHROMIUM PLATING

By Jacob Hay, C. M. Hall Lamp Company, Detroit, Mich.

One year ago today, or about that time, I presented to this Branch and the Society at large, a paper on Chromium Plating. At that time, I presented the facts as I knew them, but as time goes on we progress and for this reason I give you my experience with chromium plating according to modern standards and present day production methods.

We platers must prepare ourselves to meet any emergencies that may present themselves daily. Will we be ready to meet the call when the emergency arises? One cannot depend on outside help as outside help usually knows very little of our problems. Such help always means delay, and the results are seldom satisfactory. We are oftentimes called upon to produce 24 hours a day and must be prepared to assume the responsibility as our own. So, with this in mind, I am going to tell you what I know about chromium plating, but in order to do this I must first go into the matter of polishing and buffing.

Chromium plating brought about a radical change in polishing and buffing. In other words, we had to learn to polish and buff all over again, as metal polished and buffed for nickel finish only will not do for chromium. In nickel plating scratches may be buffed out to produce a fairly good finish, but with chromium

not only are defects in the metal magnified, but behold the scratches buffed out in the nickel all come back again.

The buffing and polishing composition is a very important factor in preparing the metal for chromium plating. The following tripoli composition I have found very satisfactory for buffing brass and also zinc die castings:

66% of pure rose colored trioline,
17% of double pressed stearic acid,
17% of good tallow.

Cleaning is another very important factor. For this reason after the metal has been cut down with tripoli on the automatic buffing machines or otherwise and all buffing machine work and stamping have been completed, the finished parts should then be cleaned in a washing machine to remove all tripoli and grease left on the surface of the metal by the preceding operations. The metal parts should then be brass colored with a lime composition. Here, too, it is very important to have a lime with a binder that will easily dissolve in the electric cleaner.

Any cleaner that will not oxidize brass or zinc die castings can be used, but remember there are some very poor cleaners on the market, and it is up to the plater to find the best cleaner adapted to his class of work.

The electric cleaner should be operated at a temperature of: about 200 degree Fahrenheit with a voltage from six to twelve. Cleaning time one and one-quarter minutes. On large production it would be well to have the following rinse method: cleaner, water rinse, cyanide dip, water rinse, acid dip consisting of 20% hydrofluoric acid, then water rinse. This method is very satisfactory for brass and die castings.

For plating brass parts, I recommend the following nickel solution:

32 oz. nickel sulphate,
4 oz. nickel chloride,
4 oz. boric acid,
2 oz. sodium sulphate.

This type of solution when first made up will have a P. H. of about 5.4. I would then add enough sodium perborate to bring the P. H. to 5.9. This solution gives the best results at a temperature of 120 degrees Fahrenheit, and 30 amperes per square foot. Running time 13 minutes. We then have a deposit of three ten-thousandths of an inch. This amount of nickel is very

essential for a good substantial chromium plate.

For die castings (nickel before chromium plate) I recommend the following solution:

10 oz. single nickel salt,
2 oz. ammonia chloride,
3 oz. boric acid,
24 oz. sodium sulphate anhydrous,
Water, 1 gallon.

P. H. from 5.9 to 6.1. Temperature for this bath should be 80 degrees Fahrenheit. Nickel plating zinc die castings in this solution is very satisfactory, and one will not have any nickel peeling in connection with the later chromium deposit, and the finish will also stand up very satisfactorily under all atmospheric conditions.

Parts nickel plated should then be nickel colored with lime composition of a high quality. This lime should have a composition made with a binder of stearic acid only, as it is very poor policy to use a strong cleaner in attempting to dissolve unsoluble greases. If you do use a strong cleaner, you may find that you have to increase the voltage of the chromium tank two volts more than if you use mild cleaners only.

The following method can be used for cleaning nickel before chromium plating: electric cleaner at six volts, temperature 180 degrees Fahrenheit, cold water rinse, acid dip consisting of hydrochloric acid. Keep at 4 degrees Beaumé; 2 water rinses afterwards, then ready for chromium plating.

Now gentlemen, you have heard the methods of procedure to prepare metals for chromium plating. The next step will be to prepare the chromium solution. I bolt the lead anodes to the positive copper buss bars. Add enough water in the tank to fill a little more than half full. I then hang old hooks on the negative bars and heat the water to 150 degrees Fahrenheit. Then start the generator set. I bring the voltage to seven or eight volts and add enough chromic acid to bring the solution to 32 degrees Beaumé. This done, I add enough water to fill the tank. The Beaumé of the solution will then be about 22 degrees at a temperature of 112 degrees Fahrenheit. I then take parts to be chromium plated and hang them in the solution. If the parts show a brown discoloration, I add sulphuric acid until I get a very good bright chromium plate. Right at this point, we analyze the solution for sulphuric acid. The best acid concentration for our work is two-tenths of one per cent. We proceed as follows:

Analysis Chromic Acid Plating Solution
Sulphuric Acid Method No. 1

For the analysis take a 10 cc. sample of the plating solution, measured accurately out of a burette.

Procedure.—Dilute this sample to about 200 cc. and add 10 cc. of concentrated HC_1 and 15 cc. Glacial Acetic Acid. Bring to a boil and while boiling slowly add 5 cc. of 10% B_aC_{12} solution. Continue boiling for five to ten minutes and let stand in a warm place for 3 to 4 hours. Filter, wash thoroughly with hot water and then wash at least five times with a boiling hot 1% HC_1 solution. Wash free from acid with hot water, ignite in a platinum crucible and in an inclined position, and weigh the barium sulphate. The barium sulphate should be heated only to a dull red heat. In no case should it be heated over the blast-lamp.

The calculation is as follows:

g. B_aSO_4 × factor for the substance × 13.352—ounces substance per gallon of plating solution.

Log. — 13.352 is 1.12556.

Example.—10 cc. of plating solution after being treated as above yielded 0.9807 grams B_aSO_4. It is desired to know how much H_2SO_4 66_0 Beaume is in the solution.

0.9804 × 0.45087 × 13.352 = 5.9021 ounces H_2SO_4 66_0 Beaumé per gallon of plating solution.

Analysis Chromic Acid Plating Solution
Sulphuric Acid Method No. 2

For the analysis take a 10 cc. sample of the plating solution, measured accurately out of a burette.

Procedure.—Dilute this sample to about 100 cc., heat to boiling and add 1 cc. of concentrated hydrochloric acid, and, then add a boiling hot 10% solution of Barium Chloride, drop by drop with constant stirring.

When the precipitation is complete, 1-2 cc. more of the reagent are added and the precipitate is allowed to settle on the water-bath. This takes place quickly if the two solutions are hot. After the precipitate has settled it can be filtered immediately. If only small amounts of sulphuric acid are present, it is best to let the solution stand twelve hours before filtering. The clear, supernatant liquid is poured through a filter and the residue in the beaker is covered with 50-100 cc. of boiling water, and after allowing the precipitate to settle for a few minutes, the clear

liquid is poured off. The decantation is repeated four times, after which the precipitate is transferred to the filter and washed with boiling water until 3 cc. of the filtrate will no longer show a test for barium on the addition of a drop of dilute sulphuric acid. The precipitate is dried somewhat, then ignited in a platinum crucible and weighed as barium sulphate.

The precipitate should be heated only to a dull red heat. In no case should it be heated over the blast-lamp.

Purification.—Where very accurate results are desired, it is necessary to test the purity of the precipitate as follows: After weighing, the precipitate is covered with 2-3 cc. of distilled water and two drops of double-normal hydrochloric acid are added. The crucible is then covered with a watch-glass and its contents digested for 15 minutes upon the water bath. The solution is then decanted through a small filter. This extraction with dilute hydrochloric acid is repeated from three to five times, after which the barium sulphate in the crucible is dried, the filter added and ignited wet in the inclined crucible, which is afterwards weighed.

For the highest degree of accuracy, the precipitate of barium sulphate after it has been ignited, should be fused in a platinum crucible with four times its weight of sodium carbonate; the melt extracted with water and the barium carbonate residue washed with sodium carbonate solution. After acidifying the filtrate with hydrochloric acid and boiling off the carbon dioxide, the sulphuric acid is precipitated as previously described.

Analysis Chromic Acid Plating Solution
Chromic Acid Electrometric

PREPARATION OF THE SOLUTIONS:

Standard N/10 Potassium Dichromate. This solution must be made with the utmost care and accuracy, for upon it depends the accuracy of the results obtained. For convenience, the use of "Fixanal" is recommended. If, however, this is not available, the solution may be made by accurately weighing out 4.9035 gr. of potassium dichromate and making this up to one litre.

N/10 Mohr's Salt. It is not necessary that the normality of this solution be exact, so long as it is accurately known. Weigh out approximately 40 gr. of the highest grade Mohr's Salt $(F{\cdot}SO_4)$ (NH) 4) $_2SO_4{\cdot}\ _6H_2O$. Introduce the Mohr's Salt into one litre volumetric flask; add 100 cc. of 1-3 H_2SO_4 and sufficient water to dissolve all the Mohr's Salt. After the Mohr's Salt is dissolved, dilute to the mark.

The Mohr's Salt does not keep a uniform strength over a very long period of time, and should be re-standardized at least once each day.

The standardization is as follows:

Introduce 25 cc. of the Standard N/10 Potassium Dichromate Solution into a 400 cc. beaker and dilute to 200 cc. with 10% H_2SO_4. Titrate this potassium dichromate solution with the Mohr's salt solution.

$$\frac{25 \text{ cc. Mohr's Salt Used.}}{\text{Mohr's Salt Factor.}}$$

NOTE: The factor thus obtained is the factor to be used in the calculation given, but it is as will be noticed, ten times the true normality of the Mohr's Salt Solution.

DETERMINATION:

Measure out accurately 10 cc. of the plating solution into one litre volumetric flask by means of a burette and dilute to the mark with distilled water. By means of a burette introduce 25 cc. of this solution into a 400 cc. beaker, dilute to 200 cc. with a 10% solution of H_2SO_4. Titrate with N/10 Mohr's Salt.

CALCULATIONS:

The calculations of the results are as follows:

cc. N/10 Mohr's Salt $\times$ Mohr's Salt Factor $\times$ 1.7805 ounces Chromic Acid per gallon.

Log. 1.7805 is 0.25054.

Analysis Chromic Acid Plating Solution

Chromic Acid Iodimetric

PREPARATION OF THE SOLUTION:

Standard N/10 Potassium Dichromate. This solution must be made with the utmost care and accuracy, for upon it depends the accuracy of the results obtained. For convenience the use of "Fixanal" is recommended. If, however, this cannot be obtained, the solution may be made by accurately weighing out 4.9035 gr. of potassium dichromate and making this up to one litre.

Potassium Iodide Solution 10%. The potassium iodide used should be "free from Iodate." It is recommended that this solution be prepared in small quantities as needed, as follows:

Dissolve approximately 10 gr. of potassium iodide in 90 cc. of distilled water.

Starch Indicator. Mix 1 g. potato starch into a thin paste with cool distilled water, and pour into 200 cc. of boiling water with continuous stirring. Let boil for a few minutes and then let

stand quietly for several hours. Pour off the clear supernatant fluid and preserve in tightly stoppered bottles with the addition of a few drops of chloroform.

Hydrochloric Acid 4N. Dilute 350 cc. of C. P. Hydrochloric acid (35-36% sp.g. 1.18) to one litre with distilled water.

Sodium Thiosulphate. ($N_{a_2}S_2O_3.5H_2O$). N/10. Dissolve 25 gr. of the highest grade crystallized sodium thiosulphate in distilled water that has previously been boiled and cooled, and dilute to the mark.

STANDARDIZATION:

In order to obtain accurate results, the directions as to quantities and time must be followed to the letter. Introduce from a burette into each of two glasses, stoppered, 25 cc. Erlenmeyer flasks, 25 cc. of the N/10 potassium dichromate standard solution. Add 10 cc. of the 10% potassium iodide solution, using a pipette or graduated cylinder and 65 cc. of distilled water. Shake well by twirling the flask and add 20 cc. of approximately 4N hydrochloric acid. Insert the stopper immediately, shake thoroughly by twirling and titrate at once as follows:

Add the sodium thiosulphate solution until the color of the iodine is almost gone. Wash the stopper and the sides of the flask with a small stream of distilled water, and add five drops of the starch indicator. Then add additional sodium thiosulphate solution carefully (until a drop destroys the last trace of blue color. This end point is very sharp).

25 cc. sodium thiosulphate solution sodium thiosulphate factor.

NOTE: The factor thus obtained is the factor to be used in the calculations given, but it is, as will be noticed, ten times the true normality of the sodium thiosulphate.

NOTE 2: The best flask to use for the purpose, is an Erlenmeyer flask with a deep gutter, which is especially made for iodine determinations. If this is not available, however, any glass stoppered flask may be used.

DETERMINATION:

Measure out accurately 10 cc. of the plating solution into a one litre volumetric flask by means of a burette and dilute to the mark with distilled water. By means of a burette introduce 25 cc. of this solution into each of the two 250 cc. volumetric flasks as described in the "Standardization" of the sodium thiosulphate solution. Add 10 cc. of the 10% potassium iodide solution, using a pipette or graduated cylinder and 65 cc. of distilled water. Shake

well by twirling the flask and add 20 cc. of approximately 4N hydrochloric acid. Insert the stopper immediately, shake thoroughly by twirling and titrate at once as follows:

Add the sodium thiosulphate solution until the color of the iodine is almost gone. Wash the stopper and the sides of the flask with a small stream of distilled water, and add five drops of the starch indicator. Then add additional sodium thiosulphate solution carefully until a drop destroys the last trace of blue color. This end point is very sharp.

CALCULATIONS:

The calculation of the result is as follows:

cc N/10 Sodium Thiosulphate $\times$ Sodium Thiosulphate Factor $\times$ 1.7805.

Ounces Chromic Acid per gallon of plating Solution.

Log. 1.7805 is 0.25054.

In controlling the chrome plating bath, it is also necessary to determine the percentage of C_rO_3, so that in bringing the solution up to strength after it has been in service, the same ratio between the C_rO_3 and $H_2\ SO_4$ can be restored. In plating tanks equipped with lead anodes, which is the case at our plant of the C. M. Hall Lamp Company, very little chromium dichromate is formed and since about 99% of the solids in the bath is chromic acid, its approximate concentration is most readily obtained by means of a hydrometer and a density table such as the one attached. For instance, if you want a solution of 22 Beaumé density, you need 42 oz. of chromic acid per gallon. For practical purposes the result will prove sufficiently accurate.

The data necessary for control of chrome plating bath then involves only the specific gravity of the solution and the percentage of sulphate calculated as $H_2\ SO_4$. If sulphate was not lost by dragout spraying it would only be necessary to replace the CRO_3, but since these losses cannot be prevented, additional $H_2\ SO_4$ must be added to keep the ratio constant.

In dealing with chemicals of 100% purity, a very satisfactory practical ratio of C_rO_3 to $H_2\ SO_4$ is 100 to 1 by weight. In other words, for every 250 grams of C_rO_3 per litre of solution, there should be present 2.5 grams of H_2SO_4 in order to insure satisfactory plating. Although .20 or .02 per cent is a good standard. When making up the solutions the purity of the C_rO_3 should be known so that allowance can be made for this reason: the regular 99% C_rO_3 containing less than .05 sulphate, and pure concentrated $H_2\ SO_4$ should be used.

You will appreciate that the ratio of 100:1 is only a typical example, and cannot be utilized in all cases, because of the different classes of work and the conditions of plating. I suggest therefore that the bath be analyzed when it is producing perfect results, and whatever ratio between the C_rO_3 and H_2SO_4 is found by the above method to use as a standard.

TABLE No. 1

Chromium Plating

This table pertains to quality plating, as on Radiotor Shells, Fixtures, etc., and automobile lamps.

Conditions: Heavy Solution 22 Be. Temp. 45 to Gr. Centigrade Current Density 1 Amp. Sq. In. Efficiency 15%.

Plating Time, Minutes	Thickness, Inches	Coverage per Lb. of Metal, Sq. Ft.	Weight of Metal Deposited, Oz./Sq. Ft.
1	.0000042	6600	.00235
2	.0000084	3300	.0047
3	.0000126	2200	.00705
4	.0000168	1650	.0094
5	.0000210	1320	.01175
6	.0000252	1100	.01410
7	.0000294	942	.01645
8	.0000336	842	.01880
9	.0000378	732	.02115
10	.0000420	660	.02350
15	.0000630	440	.03525
20	.0000840	330	.04700
30	.0001260	220	.07050
45	.0001890	146	.10575
60	.0002500	110	.14100

June 15, 1928.

TABLE No. 2

TABLE NO. 2. DENSITY OF CHROMIC ACID SOLUTIONS AS A FUNCTION OF THE C_rO_3 CONTENT

Density, 40° F.—15° C.	g/L C_rO_3	Oz./Gal. Content
1.01	15	2.0
1.02	29	3.9
1.03	43	5.8
1.04	57	7.6
1.05	71	9.5
1.06	85	11.4
1.07	100	13.4
1.08	114	15.3
1.09	129	17.3
1.10	143	19.1
1.11	157	21.0
1.12	171	22.9
1.13	185	34.8
1.14	200	26.8
1.15	215	28.8
1.16	229	30.6
1.17	243	32.6
1.18	257	34.4

1.19	272	36.4
1.20	288	38.6
1.21	301	40.3
1.22	316	42.3
1.23	330	44.2
1.24	345	46.2
1.25	360	48.2
1.26	375	50.2
1.27	390	52.2
1.28	406	54.5
1.29	422	56.5
1.30	438	58.7
1.31	453	60.7
1.32	468	62.7
1.33	484	64.8
1.34	500	67.0

Referring to this table, I might state that we proceed as follows in adding chromic acid to our solutions to bring up Beaumé —For instance, if the solution is 20 Beaumé and it should be 22 Beaumé, 22—20=2. 2×.17, which is the factor,=.34. .34×260 which is the number of gallons = 92.4 lbs. of chromic acid.

TABLE No. 3

Strength of Solutions

% vs. Lbs. per Gal.

Lbs. Solute per gal. of solution
= Sp.g (60°) × % × 0.832823
= % solute in solution
= Lbs. per gal. / (Sp.g. × 0.0832823)
Log. 0.0832823 8.92055
Oz. solute per gal. of solution
= Sp.g. (60°) × % 1.3325
= % solute in solution
= Ozs. per gal. / (Sp.g. × 1.3325
Log. 1.3325 0.12467

TABLE No. 4

			A to B	B to A	
A	B	Factor	Log	Factor	Log
H_2SO_4	SO_4	0.97945	9.99098	1.0212	0.00912
H_2SO_4	SO_3	0.81632	9.91186	1.2564	0.09914
H_2SO_4	H_2SO_4 66°	1.0731	0.03063	0.9319	9.96937
$BaSO_4$	H_2SO_4	0.42016	9.62342	.....	.....
$BaSO_4$	H_2SO_4 66°	0.45087	9.65405	.....	.....
$BaSO_4$	SO_4	0.41153	9.61440	.....	.....
$BaSO_4$	SO_3	0.34299	9.53528	.....	.....

Factors showing the relation between any two of the above given formulae may be obtained by obvious calculations from the factors already given.

The Molecular Weights used are:

H_2SO_4	98.08	Log—99158
SO_4	96.064	Log—98256
SO_3	80.064	Log—90344
H_2SO_4 66°	105.25	Log—02221

These Are Factors for Sulphuric Acid

Gentlemen, when I think about chromium plating of the past four years, and the experiences I have had, I cannot help but quote our very dear friend and member, Past Editor Mr. Richard Hedley, which reads as follows:

Chromium Jingles

Oh, listen you platers and you shall hear
All chromium plating problems made clear,
Just exactly how it is done
What you must do and what you must shun,
Take my advice and sidestep all woe
For I'll tell you all that there is to know.
Lots of chrome formulas come to your sight
Choose any one for they're all of them right,
They all have been successfully tried,
The main thing is chromium trioxide.
Use chromic acid and water sufficient
Of both and each to make it efficient
Add some chrome sulphate so much and no more
Or a wee drop of $H_2 SO_4$
It ain't your chromium education
The trick is in the manipulation.
Keep the solution at 115 in the shade
Or just about 45 centigrade.
This chromium stuff has awful bad breath
So ventilate good or you'll sure choke to death.
Use 200 amps. for each square foot of cathodes
And use steel, iron, or lead for the anodes.
Just one thing about chrome plating
Won't make you sigh
Just wipe off the work and put it in dry
Use conductors and racks that are heavy and strong
Have everything right and nothing wrong,
Observe these instructions and all will go well
For you sure must admit they're simple as *H—l.*

There is more truth in this than we realize, so I will proceed

to explain all the facts that Mr. Richard Hedley brought out in his thought. First, take a solution, for instance of the following formula:

Water .....1 gal.
Chromic Acid .....25 to 50 oz.
Chromate of Iron Fine Powder.....1 to 2 oz.
Chromic Sulphate .....½ to 1 oz.

Then, here is another formula:

Water .....1 gal.
Chromic Acid .....48 oz.
Iron Chromate .....1½ oz.
Sulphuric Acid 60° Beaume .....½ oz.

Then here is one more which I believe is one of the latest of its kind:

Chromic Acid .....48 oz.
Iron Chromate .....1½ oz.
Chromium Carbonate .....¾ oz.
Water .....1 gal.

Gentlemen, if you should make up a solution of these formulae and one of you would get results and another would make up the same solution and get no results, what is wrong? The answer to this question is very simple—as chromic acid and sulphuric acid are the only ingredients that really count in a chromium solution, it is very easy to see why would one get good results and the other would not. Let me explain them: In the first formula the iron chromate is absolutely useless, and the only reason you get a chromium deposit is because of the high sulphuric acid content, and the high voltage you have to use to reduce the Ions and at the same time deposit chromium. In other words, the excess of sulphuric acid will take up iron chromate, and only then can you get a good chromium deposit. This is one of the reasons why Oscar Servis found that by adding iron chromate he ruined his solution. Had Mr. Servis increased his sulphuric acid content, he undoubtedly would have obtained a very good deposit. On the other hand, he removed the iron chromate by filtering his solution, which solution then operated satisfactorily.

By the way, I might state that Mr. Servis recovered all but 2 oz. of all the iron chromate that he added from 50 oz.

The third formula is more simple than the two first ones. The only reason you could get a deposit, if any, would be that the

chromic acid the party used was high in sulphate, and the chromium carbonate and the iron chromate settled to the bottom. The only thing that was really active in the solution was chromic acid and H_2SO_4.

Should any of your gentlemen doubt this, get a copy of Mr. Richard Schneidwind's paper on the study of patents on Electrodeposition of chromium, and you will find a very good explanation there. So, that is the very reason why all of them are right, according to Mr. Richard Hedley. Accordingly, only chromic acid of the highest quality, and if possible, free from sulphuric acid, should be purchased, as then and only then can you get consistent results in production.

I have found that by using chromic acid almost free from sulphuric, and making daily additions of chromic acid, we keep our sulphuric acid content .02 per cent over a period of two weeks, with only 50 cc. of sulphuric acid added. The number of pieces plated were approximately 72,000 per day, so you can easily see it is not in your chromium education, but in the manipulation. The temperature is very important. Ventilation is also a very important thing, from the standpoint of health of the operator. By having good ventilation none of our operators were affected and lost no working time on account of chromium sores or fumes, and the loss of chromium by the exhaust is very small.

In regard to anodes that should be used in chromium solutations --Dr. O. P. Watts of the University of Wisconsin in his paper to the American Electro Platers Society in Detroit, on December 14, 1927, leaves no doubt that the lead anode is the proper anode to use. Some others recommend steel and lead anodes. I, for my part, believe that steel anodes will be the only ones active, and the lead anode will be inactive due to the fact that the lead anode will become covered with the lead peroxide, and as electric current follows the line of least resistance, we might as well leave the lead anodes out if steel anodes are used.

Lead anodes can easily be cleaned in cleaner with reversed current in a solution of:

Coustic soda
Sodium cyanide
Soda ash

Another good way to clean the scale off lead anodes is to take and try the anodes and then run them through a rolling machine.

The scale will crack off, and can be removed with a steel wire brush very easily.

Gentlemen, in order to explain my theory about lead anodes, I will give you two different chemical analyses of solutions as I found them, so let us call them No. 1 and No. 2. Here is what we found:

	No. 1	No. 2
Chromic acid	43.5 oz.	35.00 oz.
Chromic oxide	1.91	.87
Sulphuric acid	1.84	.68
Iron chromate	2.64	.00
Copper	2.00	1.00
Zinc	1.00	.50
Beaume at 84°F.	30.°	24.°

Usually at 31 degrees Beaume, solution No. 1 should have 56 oz. of chromic acid, and the actual amount of chromic was only 43 oz., so if you use steel anodes you not only have to use high sulphate content and high voltage, but you cannot even get a correct Beaume reading. Solution No. 2, as you notice, was almost perfect, except that the sulphate content was a little high, and I believe the sulphuric acid content had to be kept that high on account of the copper and zinc present in the solution. Both of these solutions were operated for a period of six months. No. 1 had steel anodes, and No. 2, had lead anodes.

On the other hand, I will give you two analyses of two solutions with lead anodes, only to prove that by having any other ingredients than chromic acid and sulphuric acid in the solution, you will invite trouble.

Chemical analyses of the solutions showed the following:

	No. 1	No. 2
Chromic Acid as C_r0_3	388. g/2	396. g/1
Chromic Acid as Cr_6	202.	206.
Sulphate as SO_4	4.43	8.76
Trivalent Chromium as Cr_3	5.03	5.76
Iron as Fe_3	4.28	6.35
Copper as Cu	.....	5.21
Zinc as Zn	.....	4.63
Nickel as Ni	.....	.....

This again would prove that the sulphate content was kept high in bath No. 2, on account of metals that did not belong there. The difference in voltage we had to use was also large, as No. 1 bath would give a very good deposit at 5 volts, whereas No. 2 would require 8 and 9, for the plating of the same parts. This would then prove if one has to go above 7 volts, the chrome solution would not be normal, and the H_2SO_4 would be too high. On the other hand, if one has to use high voltage and the amperage is

low then one would not have enough H_2SO_4, or else the anodes are insulated with lead peroxide and it might be poor contact of the anodes.

It is well to watch the ammeter at all times as it plays a very important part in chromium plating. The ammeter is as important in chromium plating as in operating a brass solution. For instance, if you have a tank load of which you know from experience, would require 3000 amperes, and then all at once it drops to 2000 amperes, what would it prove? It would prove that either the anodes are not active or the sulphate content in the chromium solution is off, providing of course, that temperature and other conditions are correct.

Cleaning material before chromium plating has its problems, and I believe it is mostly on account of the chromium solution that the operator carries back into the cleaners from the plating hooks. That is one reason why I believe plating hooks should be washed very carely in rinse, and by spray, before using them again, as the chromic acid carried into cleaners forms sodium chromate and finally destroys all the alkaline in the cleaner and the life of the cleaner is very short.

Racks for chrome plating will always be a problem for each industry to work out, as that is really one of your most important problems, for good chromium plating.

All material should be plated under spring tension, so you can see if we observe instructions all will go well, for you surely must admit they're simple.

By Jacob Hay,
C. M. Hall Lamp Company,
Detroit, Mich.

REPORT OF CONFERENCE ELECTROPLATING RESEARCHES OF THE BUREAU OF STANDARDS

April 6, 1929

During the past few years conferences have been held at the Bureau of Standards to discuss the progress of the researches on electroplating and appropriate subjects for future research by the Bureau Staff and the Research Associates of the American Electroplaters' Society. This year, at the invitation of the Newark Branch and the Research Committee of the Electroplaters' Society the conferenec was held in Newark on April 6th, from

9 A. M. to 5 P. M. O. J. Sizelove of the Newark Branch presided at the morning session, and R. J. O'Connor, chairman of the Research Committee, at the afternoon session. About 250 persons attended the meetings, at which the following subjects were presented and discussed.

1. *Spotting Out.*—W. P. Barrows, Research Associate of the American Electroplaters' Society, presented a summary of his investigation of spotting out. The detailed results of this study are now in press, as a Research paper of the Bureau of Standards, which will appear about June 1. As copies of this paper will be distributed by the Electroplaters' Society to all of its members, and to all subscribers to the Research Fund, it will not be necessary to give the details in this report. The study showed that there are two distinct types of spots on finished or plated metals such as builders' hardware.

The "crystal spots" consist of radiating black crystals which form only on metals that have a copper sulphide ("oxidized") finish and are lacquered. These spots are caused or accelerated by the presence of even small amounts of sulphur, which may come from adjacent sulphur, rubber, paper or cardboard. The most effective remedies are (a) the use of lacquers found to retard such spotting, (b) the application of a thin grease film, and (c) the use of wax paper for wrapping.

The "stain spots" occur chiefly on cast metals, pores in which absorb substances from the cleaning or plating solutions. On subsequent exposure to a moist atmosphere, such compounds take up water and spread over the metal surface, causing stains of variable color and shape. The most effective remedies were found to be (a) allowing the plated articles to "spot out" by exposure to a moist atmosphere before they are given a final finishing; and (b) the application of a lacquer that has been found to prevent the absorption of moisture by the substance in the pores. Early tests showed that for this purpose the phenol-condensation lacquers are superior to the ordinary nitrocellulose lacquers. Recent tests on 24 commercial lacquers show that some of the latter type are also very efficient in preventing stain spotting.

In the discussion of this report it was pointed out that this investigation has shown for the first time the very important relation between the lacquer coating and these two types of spots.

2. *Chromium Plating.*—A summary of the researches of the

Bureau on chromium plating was presented by W. Blum, chief of the Electrochemistry Section.

(a) The first study was on the application of chromium to the intaglio printing plates at the Bureau of Engraving and Printing. This process is now used successfully on the plates for printing most of the paper currency and postage stamps.

(b) A general survey of the chromium plating solutions and operating conditions was made a few years ago by H. E. Haring and W. P. Barrows and published as Bureau of Standards Technologic Paper 346, a copy of which may be obtained by sending 15 cents to the Superintendent of Documents, Washington, D. C. Over 5,000 copies of this paper have been sold.

(c) In co-operation with the U. S. Public Health Service, a study was made of the Health Hazards in Chromium Plating. The conclusion from this study and from the literature was that the principal injurious effect of chromic acid spray is upon the nasal tissues, and that no systemic poisoning occurs. As very low concentrations of chromic acid in the air cause injury to the nasal tissues, good ventilation is essential. This is preferably secured by drawing air transversely across the surface of the tanks and into narrow slots, at a velocity of 1,500 to 2,000 feet per minute. The formation of "chrome sores" or ulcers on the skin can be prevented by the use of rubber gloves, or by occasional applications of vaseline. If such sores form, a reducing agent such as hypo, or the sulphide solutions used in "oxidizing" metals, should be applied.

Details of this investigation were published in Reprint No. 1245 of Public Health Reports, by J. J. Bloomfield and W. Blum. A copy of this paper may be obtained on request addressed to the Bureau of Standards.

(d) A survey of the mechanical applications of chromium plating was made and published in a paper by W. Blum in Mechanical Engineering for December, 1928. This study showed that chromium is very valuable for increasing the life of gages and dies, but is not entirely successful in cutting tools.

(e) At the request of the Federal Specifications Board, a specification for chromium plated plumbing fixtures was prepared. This specification has been adopted but not yet promulgated. It is based on information available regarding present accepted practice, and not on any actual study of the service of chromium plated fixtures. It may therefore require revision in

the light of experience and research. It provides that brass fixtures shall be plated either with (a) 0.0002 inch of chromium, or (b) 0.0002 inch of nickel plus 0.00002 inch of chromium.

(f) In a research in progress by H. R. Moore of the Bureau of Standards upon the constitution of chromium plating baths, it has been found that solutions of pure chromic acid have a maximum conductivity when the concentration of chromic acid is about 5 *M*, i.e., 500 g/L or 67 oz/gal of CrO_3. Further studies are in progress upon the effect of trivalent chromium upon the conductivity and other properties of chromic acid solutions.

(g) H. L. Farber, Research Associate of the American Electroplaters' Society, presented a progress report of a study of throwing power in chromium plating. As the effects of trivalent chromium and iron are still to be studied, the following conclusions must be considered as tentative.

To obtain satisfactory bright deposits of chromium upon irregularly shaped articles, it is necessary to consider the following factors:

(1) The current distribution should be made as uniform as possible, as it is usually difficult to produce bright deposits if the ratio of the maximum to the minimum current density is greater than 3:1, or in some cases 2:1. Much of the industrial success in the last few years has come from the exercise of ingenuity in securing a nearly uniform current density on the articles to be plated. In general this may be accomplished by one or more of the following methods.

Have the anodes close to and parallel with the cathode surfaces. Thus an anode may be inserted inside of a tube or a reflector, or projecting portions of the anode may extend into depressions on the cathode.

Have the anodes and cathodes as far apart as practicable, e.g., from 12 to 18 inches apart.

So suspend the articles on the racks that conducting portions of the latter are close to those portions of the cathodes that tend to have excessive current densities.

Shield projecting portions of the cathode with non-conducting plates or rods, e.g., of glass.

(2) The conditions should be selected which will produce bright deposits at the minimum and maximum current densities existing on the cathodes. In general the plating range for bright deposits is wider at high temperatures and current densities than at low.

It is also wider on brass and copper than on steel or nickel. Bright deposits are usually obtained on brass when the cathode efficiencies are between 5 and 20 per cent, and on steel between 8 and 18 per cent.

(3) The conditions for best throwing power should be selected, i.e., the bright deposits should be as nearly uniform in thickness as possible over the whole surface. Throwing power is defined as the "improvement in per cent, of the metal ratio above the primary current ratio." As in chromium plating the metal ratio is always less uniform than the primary current ratio, all the numerical results are negative. A value from 0 to —25 per cent is a good throwing power, one below—100 per cent is a poor throwing power.

Measurements were made in a glass-lined throwing power box, with a primary ratio of 2:1. It was found that the polarization and the conductivity have practically no effect on the throwing power. The latter is determined almost entirely by the relation between the cathode efficiency and the current density. Suppose that, with a 2:1 ratio, the cathode efficiencies are 16 and 8 per cent respectively. Then the metal ratio is 4:1 and the throwing power is —100 per cent. If under other conditions the cathode efficiencies are respectively 15 and 10 per cent, the metal ratio is 3:1 and the throwing power is —50 per cent. In general those conditions should be selected under which the cathode efficiencies are most nearly uniform.

The separate effects of the principal factors are as follows:

(1) A higher content of chromic acid increases the conductivity, but decreases the throwing power.

(2) A decrease in the relative sulphate content, so that the ratio of CrO_3/SO_4 is about 200:1, increases throwing power. (With a 100:1 ratio, recommended in Tech. Paper 346, the average cathode efficiency is higher, but the actual cathode efficiencies are less uniform than with a 200:1 ratio.)

(3) Neither boric acid nor sodium dichromate produces any appreciable improvement in throwing power.

(4) An increase in temperature at the same current density decreases throwing power.

(5) An increase in current density at the same temperature increases throwing power.

(6) The maximum throwing power with bright deposits is obtained at a high temperature and high current density.

(7) Very good throwing power is obtained in a solution containing 250 g/L (33 oz/gal) of CrO_3 and 1.25 g/L (0.16 oz/gal) of H_2SO_4, at a temperature of 55° C. (131° F.) and an average current density of about 30 amp/dm² (280 amp/sq. ft.). This will usually require over 8 volts. If therefore only 6 volts is available it may be preferable to use a stronger (and hence better conducting) solution, e.g., one with 400 g/L (53 oz/gal) of CrO_3 and 2 g/L (0.27 oz/gal) of H_2SO_4, at a temperature of 35° C. (104° F.) and an average current density of about 6 amp/dm² (56 amp/sq. ft.), although the throwing power and plating range will not be so favorable as under the preceding conditions.

The presentation of this paper was aided by charts and tables, which will be included in the printed report of the completed investigation.

In the discussion of chromium plating numerous questions were asked and details were considered. No significant contradictions of any of the above conclusions were reported, but many subjects for additional study were pointed out.

3. *Analysis of Cyanide Solutions.*—M. R. Thompson of the Bureau of Standards reported that after many trials very nearly pure sodium and potassium cyanide have been prepared for research purposes. Analyses of these materials indicate that the "Leibig" titration with silver nitrate is accurate. The end point is made more sensitive by the addition of potassium iodide. With this modification the results are not appreciably affected by any of the constituents likely to be present in sodium or potassium cyanide or in silver plating solutions. The method is therefore reliable for determining the free cyanide in silver baths. It is planned to extend this work to include other cyanide plating solutions, such as of copper, zinc, brass, cadmium and gold.

In the discussion of this paper it was pointed out that in brass plating solutions, carbonates interfere with the silver nitrate titration for free cyanide. If the carbonate is precipitated with barium nitrate and the barium carbonate is filtered out, accurate results can be obtained by the silver nitrate titration in the presence of iodide.

4. *Measurement of pH in Nickel Plating Solutions.*—For the past several years, many electroplaters have used colorimetric methods for the measurement of the pH (or acidity) of nickel plating baths, and have thereby obtained much more uniform de-

posits. About two years ago another method known as "quinhydrone electrode" was applied for this purpose and has been used in a few plants. About a year ago it was pointed out that the results obtained by these two methods are not consistent. In order to determine the relation of such discrepancies to the composition of the nickel baths, a joint investigation was arranged. Forty nickel solutions were prepared from purified materials by N. Bekkedahl at the Bureau of Standards. Each contained in addition to nickel sulphate, one or more of the common constituents or impurities of nickel baths. They therefore represented all types of nickel plating solutions. These were distributed to different laboratories and measurements were made on them by the following persons:

1. K. Pitschner—American Chain Co.
2. (a) H. C. Parker—Leeds & Northrup Co.
   (b) C. C. Coons—Leeds & Northrup Co.
3. F. R. McCrumb—LaMotte Chemical Products Co.
4. A. K. Graham—University of Pennsylvania.
5. (a) E. W. Skelton—University of Toronto.
   (b) C. J. Colombo—University of Toronto.
   (c) J. T. Burt-Gerrans— University of Toronto.
6. N. Bekkedahl—Bureau of Standards.

The results were assembled and discussed by the above persons prior to April 6th. There was substantial agreement regarding the facts obtained and the principal conclusions, but no specific recommendations were agreed upon. It is hoped that at the convention of the American Electroplaters' Society in Detroit in July, some definite recommendations may be presented. The results may be briefly summarized as follows:

(a) The hydrogen electrode is the primary basis of all pH measurements. As the equipment required is somewhat expensive and involved, and as errors are produced by impurities such as copper and lead that may be present in commercial nickel solutions, the hydrogen electrode is not suitable for works control. Whenever reliable values can be obtained with the hydrogen electrode, the results represent the true pH.

(b) The results with the quinhydrone method are about 0.05 pH above those with the hydrogen electrode. The equipment is more intricate and expensive than that for colorimetric measurements. The results can be quickly obtained, and are free from any personal estimate of color.

(c) The colorimetric readings are in all cases considerably higher than the hydrogen electrode values. This is because of the well-known effects of high salt concentrations upon the color of indicators. As most colorimetric pH measurements in other industries are made in dilute solutions, the salt errors in such measurements are usually negligible. Nickel plating solutions are relatively concentrated and hence produce larger salt effects.

(d) In general the salt error increases with the total concentration of salts present. Most nickel plating solutions are from 1.0 *N* to 2.0 *N*. in total salt content (i.e., they contain roughly from 20 to 40 oz/gal of nickel sulphate and other salts). Such variations in total salt content do not change the salt error of the indicator by more than about 0.1 pH from the average value.

(e) Most of the constituents of nickel baths have no large specific effect on the salt error. Fluorides and citrates somewhat reduce the magnitude of the divergence.

(f) Solutions containing much iron change rapidly in pH, and are difficult to measure by any methods. The results, while less reliable than with iron absent, indicate that the deviation between the quinhydrone and colorimetric methods is about the same as in other solutions.

(g) The magnitude of the deviation varies with the colorimetric method used, and the basis of its standardization.

(h) Increasing the temperature of nickel solutions decreases the pH of the solution, as measured by any reliable method. The decrease in pH is greater with solutions containing ammonium salts. In addition to the actual change in pH at high temperatures, the colorimetric method may be affected by the change produced by heat upon the color of the indicator and of the nickel solution. Therefore all pH measurements of nickel baths should be made at ordinary temperature, even though the baths may be operated at elevated temperatures.

(i) The average deviation of the colorimetric results from the hydrogen electrode is about 0.5 pH, although with different solutions or different indicators, the deviation may range from 0.3 to 0.6 pH.

No formal recommendations were made to the conference. It was generally agreed by those engaged in the study that if feasible all pH measurements in nickel plating should be based upon and expressed in terms of the hydrogen electrode values. In this way the results of investigators or operators who use

different methods of measuring pH will be on the same basis, and confusion will be avoided. Among the methods that were discussed for accomplishing this end were the following:

(a) The use of the quinhydrone electrode, which involves a negligible correction.

(b) The use of present colorimetric standards and methods and the application by each operator of a deduction of 0.5 pH as an average deviation.

(c) The use of present colorimetric standards with a specific deduction that has been actually determined for that method and type of solution.

(d) The use of colorimetric standards especially calibrated for nickel plating, the values on the labels of which have been corrected by some fixed amount, e. g., 0.5 pH.

By any one of these procedures, measurements can be made as reproducibly as at present; and the corrected values will agree with the true pH within 0.1 or in a few cases 0.2 pH.

In the discussion of this subject procedure (c) was especially favored. All of these possibilities will be considered in a small conference to be held prior to the Electroplaters' Convention, and to the detailed publication of the results and conclusions.

5. *Addition Agents in Copper Electrotyping Solutions.*—R. O. Hull, Research Associate of the International Association of Electrotypers. In solutions containing 250 g/L (33 oz/gal) of copper sulphate, 75 g/L (10 oz/gal) of sulphuric acid and 1 g/L (0.13 oz/gal) of phenol (carbonic acid), added as phenolsulphonic acid, at 40°C (104°F) and with good agitation, current densities as high as 30 amp/dm² (280 amp/sq. ft.) may be used. The deposits are smoother and harder than those from solutions with no addition agent. This solution is now being tried on a commercial scale in several electrotyping plants.

6. *Iron Deposition.*—C. T. Thomas, U. S. Bureau of Engraving and Printing. In solutions containing about 300 g/L (40 oz/gal) of ferrous chloride and 355 g/L (45 oz/gal) of calcium chloride, thick smooth deposits of iron can be produced at a temperature of 90°C (196°F) and a current density of 7 amp/dm² (65 amp/sq. ft.). The free hydrochloric acid in the solution is from 0.01 to 0.02 *N*. The cathodes are moved mechanically. The anodes of rolled Armco iron are suspended in porous alundum pots, to prevent particles of anode slime from reaching the cathodes and causing rough deposits. The deposited iron has

a tensile strength of about 400 kg/cm² (5600 lb/sq. in.) and an elongation of about 20 per cent.

7. *Future Plans.*—The discussion of future plans emphasized the need for more information regarding the protective value of electroplated coatings against corrosion, as a basis for specifications of quality. It was pointed out that the various tests and specifications for zinc and cadmium coatings are not adequate. It was also stated that although chromium plating has been widely applied in the automobile and other industries, the present methods and specifications do not yield entirely satisfactory products. It was predicted that unless an improvement in the quality of chromium plating is made, the public will be disappointed in its performance, and other finishes will be substituted.

It was then suggested that in any study of the protective value of electroplated coatings, the Electroplaters' Society and the Bureau of Standards should co-operate closely with committees of the American Society for Testing Materials and similar organizations. The hope and belief was also expressed that the automobile industry as well as other metal industries will gladly contribute to the support of such an investigation.

At a subsequent meeting of the Executive Committee and the Research Committee of the American Electroplaters' Society, it was decided to have their two Research Associates undertake a comprehensive study of "Protection Against Corrosion by Means of Electroplated Finishes." Such a study will probably require about three years. The first subject to be investigated will be the protective value of chromium plating. As soon as possible the plans for this study will be prepared and discussed with interested firms and organizations.

List of Those Attending Conference

Leonard Abbotts, Bridgeport Metal Goods Co., Bridgeport, Conn.

Bjorn Andersen, Celluloid Corporation, Newark, N. J.

Ernest G. Anderson, American Hardware Corp., New Britain, Conn.

Walter G. Aurand, R. Wallace & Sons Mfg. Co., Wallingford, Conn.

Chas. S. Barbour, International Chemical Co., Windsor, Conn.

W. P. Barrows, Bureau of Standards, Washington, D. C.

J. J. Basch, Newark, N. J.

Wm. E. Baulieu, Jr., Bridgeport Brass Co., Bridgeport, Conn.

Charles F. Beck, Yale & Towne, Stamford, Conn.
Norman Bekkedahl, Bureau of Standards, Washington, D. C.
Chas. Berlun, Bronx, N. Y.
C. H. Bibler, Newark, N. J.
Adolph Bregman, *The Metal Industry,* New York City.
J. Rowland Brown, Reliance Gauge & Column Co., Cleveland, Ohio.
L. Buell, A. & T. Manufacturing Co., Binghamton, N. Y.
W. Blum, Bureau of Standards, Washington, D. C.
Ellsworth T. Candell, American Brass Co., Waterbury, Conn.
Albert Cameron, Taylor Instrument Co., Rochester, N. Y.
Guy A. Cheney, Hanson-Van Winkle-Munning Co., Matawan, N. J.
T. H. Chamberlain, New Haven Clock Co., New Haven, Conn.
Edw. H. Christ, Stanley Chemical Co., East Berlin, Conn.
Royal F. Clark, Newark, N. J.
Guy M. Cole, General Motors Corp., Detroit, Mich.
Chas. C. Conley, National Cash Register Co., Dayton, Ohio.
C. C. Coons, Leeds & Northrup Co., Philadelphia, Pa.
Benjamin Cross, Brooklyn, N. Y.
Burton S. Daw, Lasalco, Inc., Elyria, Ohio.
William DeLage, Scoville Mfg. Co., Waterbury, Conn.
J. J. Desmond, North East Electric Co., Rochester, N. Y.
William J. DeVoti, Consolidated Safety Pin Co., Bloomfield, N. J.
Thomas A. Dondi, Irvington, N. J.
George Dubpernell, Udylite Process Co., Detroit, Mich.
R. L. Duff, Standard Oil Development Co., Elizabeth, N. J.
Raymond C. Eckert, Yale & Towne Mfg. Co., Philadelphia, Pa.
F. S. Edelmann, Pyrene Mfg. Co., Newark, N. J.
Tennant Elwin, Connecticut Tel. & Electric Co., Meriden, Conn.
Edward W. T. Faint, International Motors Co., Allentown, Pa.
I. Farber, S. W. Farber, Inc., Brooklyn, N. Y.
H. L. Farber, Bureau of Standards, Washington, D. C.
John H. Feeley, Montreal, Quebec, Canada.
B. Freeman, National Chromium Corp., New York City.
M. M. Fischer, Standard Auto Radiator Co., Brooklyn, N. Y.
Harry C. Flannigan, Maas & Waldstein Co., Newark, N. J.
Walter Fraime, National Cash Register Co., Dayton, Ohio.
O. B. J. Fraser, International Nickel Co., Bayonne, N. J.

Arthur F. Frauer, Chromium Corp. of America, Waterbury, Conn.

Louis C. Gale, Gillette Safety Razor Co., South Boston, Mass.

E. L. Gann, Hanson-Van Winkle-Munning Co., Matawan, N. J.

James Gardi, Plating Eng. Co., Newark, N. J.

Sylvester P. Gartland, North East Electric Co., Rochester, N. Y.

George Gehling, Philadelphia, Pa.

A. Glickenhaus, Art Metal Works, Newark, N. J.

Henry J. Graff, Singer Mfg. Co., Elizabeth, N. J.

A. K. Graham, University of Pennsylvania, Philadelphia, Pa.

V. E. Grant, New Departure Mfg. Co., Bristol, Conn.

Fred Gumm, Newark, N. J.

Barrie A. Hackett, Bassick Company, Bridgeport, Conn.

Wilbur Hand, Newark, N. J.

Frank J. Hanlon, Chicago City Plating Co., Chicago, Ill.

Wm. F. Harrison, Newark, N. J.

P. A. Hellige, Hellige-Klett, New York City.

R. E. Hicks, Yale & Towne Mfg. Co., Stamford, Conn.

George B. Hogaboom, Hanson-Van Winkle-Munning Co., Matawan, N. J.

G. Byron Hogaboom, Jr., Columbia University, New York City.

C. M. Hoke, Hoke, Inc., New York City.

B. Holgram, Jersey City, N. J.

E. P. Holtberg, Winchester Repeating Arms Co., New Haven, Conn.

E. T. Homan, Hanson-Van Winkle-Munning Co., Camden, N. J.

J. M. Hosdowich, Chromium Corporation of America, Waterbury, Conn.

John C. Hudgins, Chemist, Taylor Instrument Co., Rochester, N. Y.

R. O. Hull, Bureau of Standards, Washington, D. C.

H. M. Johnquest, Waterbury, Conn.

Robert E. Johnson, Scovill Mfg. Co., Waterbury, Conn.

Thomas Johnson, Gillette Safety Razor Co., South Boston, Mass.

J. N. Junkins, Atlas Tack Corp., St. Louis, Mo.

Chas. Karcher, New York City.

F. T. Kelley, Westinghouse Elec. Mfg. Co., East Pittsburgh, Pa.
William J. R. Kennedy, Westinghouse Co., Springfield, Mass.
J. W. Kilduff, Aga Auto Lamp Co., Amesbury, Mass.
Albert Kirsch, Carey, McFall Co., Philadelphia, Pa.
Frank M. Koelbb, Francis Koelbb & Son, New York City.
H. C. Koseo, Yale & Towne Mfg. Co., Philadelphia, Pa.
K. Lam, Brooklyn, N. Y.
W. W. Lawson, Harshaw Chemical Co., Philadelphia, Pa.
James F. Leahy, Atlas Tack Corp., Fairhaven, Mass.
Peter Lebourk, Newark, N. J.
B. F. Lee, Boston Plating Supply Co., Boston, Mass.
Henry Levine, New York City.
Ralph J. Lignon, Bommer Springs Hinge Co., Brooklyn, N. Y.
H. Liversidge, R. Wallace Mfg. Co., Wallingford, Conn.
Raymond P. Lopez, Hickok Mfg. Co., Rochester, N. Y.
G. Lundquist, International Silver Co., Meriden, Conn.
W. D. MacDermid, MacDermid, Inc., Waterbury, Conn.
Robert D. MacLachlan, Hanson-Van Winkle-Munning Co., Matawan, N. J.
Franklin J. MacStocker, Garden City, L. I., N. Y.
Clarence B. McComas, Carr-Lowry Glass Co., Baltimore, Md.
W. W. McCord, McCord Radiator & Mfg. Co., Detroit, Mich.
F. R. McCrumb, LaMotte Chemical Products Co., Baltimore, Md.
B. H. McGar, Chase Co., Inc., Waterbury, Conn.
Wilfred S. McKeon, Sulphur Products Co., Greensburg, Pa.
H. D. McLeese, United Chromium, Inc., New York City.
N. Marketan, Chromeplate Co., New York City.
Rudolph T. Marshall, Worcester Brass & Electroplating Co., Worcester, Mass.
Rockey E. Massicotte, Hane & Broun Corp., Philadelphia, Pa.
B. A. Mein, A. C. Gilbert, New Haven, Conn.
U. A. Merlin, Crowder Laboratories, Inc., Newark, N. J.
I. Mershon, Globe Silver Co., New York City.
F. C. Mesle, Oneida Community, Sherrill, N. Y.
L. A. Meyers, Jr., Newark, N. J.
John J. Muller, Bethlehem, Pa.
A. Munger, Pyrene Mfg. Co., Newark, N. J.
Joe Murray, Crust Company, New Haven, Conn.
Joseph Musant, Jr., Glen Cove, L. I., N. Y.

Al. Musem, Rexalin Flexible Lacquer Co., Long Island City, N. Y.

Benjamin Nadel, Bronx, N. Y.

R. J. O'Connor, Contract Plating Co., Bridgeport, Conn.

L. H. O'Donnell, Jersey City, N. J.

Paul A. Oldam, Kearny, N. J.

Floyd F. Oplinger, R. & H. Chem. Co., Perth Amboy, N. J.

Ralph J. Paddock, Standard Sanitary Mfg. Co., Pittsburgh, Pa.

L. C. Pan, New York University, New York City.

John Papermanuel, Brooklyn, N. Y.

G. A. Perley, Leeds & Northrup Co., Philadelphia, Pa.

E. R. Person, Du Pont Viscoloid Co., Leominster, Mass.

C. W. Peterson, Webber Root Co., Bristol, Conn.

A. G. Pierdon, Art Metal Finishing Co., Washington, D. C.

F. F. Pierdon, Art Metal Finishing Co., Washington, D. C.

K. Pitschner, Stratford, Conn.

Adam V. Pfaff, Carr-Lowry Glass Co., Baltimore, Md.

A. Pflomm, Francis Keil & Son, Bronx, N. Y.

Charles H. Proctor, R. & H. Chem. Co., New York City.

R. Recoraro, Newark, N. J.

C. E. Reinhard, New Jersey Zinc Co., Palmerton, Pa.

George Renton, Tiffany & Co., New York.

W. G. Rinehart, American Chain Co., Bridgeport, Conn.

C. F. Robison, Jr., Darby, Pa.

W. S. Rowland, Stanley Chemical Co., East Berlin, Conn.

Paul Santelle, Arlington, N. J.

Leslie G. Saunders, R. Wallace & Sons Mfg. Co., Wallingford, Conn.

Wm. J. Schneider, R. & H. Chem. Co., New York City.

E. Schor, Bronx, N. Y.

Edward J. Schorr, Elizabeth, N. J.

Arthur Seefahrt, Jr., Winchester Repeating Arms Co., New Haven, Conn.

Dennis C. Shea, Standard Oil Development Co., Elizabeth, N. J.

Nelson F. Sievering, Philip Sievering, Inc., New York City.

Philip Sievering, Philip Sievering, Inc., New York City.

George Simmons, A. & T. Mfg. Co., Binghamton, N. Y.

H. Simon, Bronx, N. Y.

O. J. Sizelove, Aug. Goertz Co., Newark, N. J.

Thos. F. Slattery, Bureau of Engraving and Printing, Washington, D. C.

H. R. Smallman, Hanson-Van Winkle-Munning Co., Matawan, N. J.

Edwin Smith, United Chromium, Inc., New York City.

Horace H. Smith, Tiffany & Co., New York City.

M. E. Stewart, R. & H. Chem. Co., Perth Amboy, N. J.

Roy Stout, F. C. Kent Co., Irvington, N. J.

E. K. Strachan, Brown University, Providence, R. I.

W. G. Stratton, Bassett Metal Goods Co., Derby, Conn.

J. A. Straub, New York City.

J. A. Stremel, Brooklyn, N. Y.

H. D. Stephen, New Departure Mfg. Co., Bristol, Conn.

L. E. Sullivan, Matchless Polish Co., Caldwell, N. J.

Edward N. Taylor, Bart Reflector Co., Upper Montclair, N. J.

Floyd T. Taylor, Hanson-Van Winkle-Munning Co., Matawan, N. J.

William J. Taylor, Union, N. J.

T. P. Thomas, Westinghouse Elec. & Mfg. Co., East Pittsburgh, Pa.

M. R. Thompson, Bureau of Standards, Washington, D. C.

Wm. H. Torrance, The Matchless Metal Polish Co., Glen Ridge, N. J.

E. Troxler, Springfield, Mass.

Philip Uhl, Robert M. Green Sons, Philadelphia, Pa.

C. Van Derau, Westinghouse Elec. & Mfg. Co., Mansfield, Ohio.

Alfred Vaughan, East Orange, N. J.

P. F. Vogelsang, The B. J. Ford Co., Wyandotte, Mich.

John C. Vosoff, Eimer & Amend, New York City.

William Voss, Richmond Hill, L. I., N. Y.

George Wagner, Hillside, N. J.

Frederick H. Walker, Newark, N. J.

L. De Waltoff, Hotel Beacon, New York City.

Charles A. Ward, Brooklyn, N. Y.

W. S. Ward, Boissier Electric Corp., New York City.

C. J. Wernlund, R. & H. Chem. Co., Perth Amboy, N. J.

W. Andrew Wesley, International Nickel Co., Bayonne, N. J.

Paul B. Wheelan, Western Electric Co., Newark, N. J.

L. F. Wheeler, Singer Mfg. Co., Elizabeth, N. J.

Chas. G. Whitehead, R. & H. Chem. Co., Perth Amboy, N. J.

Donald Wood, Walter S. Wood Co., Boston, Mass.

E. L. Wood, Landers, Frary & Clark, New Britain, Conn.

Harold K. Work, Aluminum Co. of America, Buffalo, N. Y.

E. L. Zapp, Hyatt Bearings Div., General Motors Corp., Newark, N. J.

CHROMIUM PROBLEMS

Oscar E. Servis, Past President and Librarian Chicago Branch and Past President and Secretary-Treasurer A. E. S.

Read at Milwaukee Annual Meet, April 6, 1929

In successful plating of chromium there are many serious problems to consider. Many of these are overlooked by the authors. In all of the technical papers which have been published in the past, it seems to be their one idea to write something very scientific, and simply give the results of their experiments, without including any of their minute details of these experiments. This is perfectly all right for the well-informed chemist, but seldom offers much help to his less informed brother in the Electroplating Industry, who may not have, and probably does not have, sufficient knowledge to read between the lines and get as much data as would the better informed chemist.

One of the main problems in chromium plating is the proper use of the SO_4 Ion. Many formulas printed call for a given amount of chrome sulphate, but they do not specify which chrome sulphate should be used. There are at least three of these sulphates. One of which is not soluble in water, and appears in a powdered form. This should never be used. The other is dark green crystals and is soluble in hot solution, but contains considerable impurities. The proper sulphate to use that is sold and is satisfactory is in dark green flat scales, much resembling shellac in form, but differs in color. This salt is readily soluble in water to a complete solution. In purchasing this the "flake" should be specified.

Again, other writers mention sulphuric acid as being the proper form in which to introduce the sulphate Ion into the chromium plating bath, but seldom do we see a formula that informs the plater as to whether the SO_4 Ion should be added by liquid measure or by weight.

Since sulphuric acid has a specific gravity of 1.84, it follows that if we try to add the SO_4 Ion by measuring it in gradually instead of weighing same, we will have an excess of SO_4, because a fluid measure of 1 oz. of sulphuric acid equals 1.84 oz., there being an excess of .84 more than required.

You will gather from the above remarks that it behooves the plater to find out the value of his measuring apparatus, and in terms of SO_4 become familiar before he starts to add sulphate in his bath, and in this way avoid excess, for here is a place where one cannot trust to guesswork in the slightest degree. I might mention the early failures in chromium plating were principally due to the unjudicious use of adding sulphates to the bath.

We note a standard typical formula composed as follows:

Chromic Acid Cr. O_3 ..... 32 oz.
Sulphuric Acid $Cr._2$ SO_4 ..... .5 oz.
Water ..... 1 gal.

This calls for 32 oz. Cr O_3 avoirdupois weight, and unless otherwise specified, we assume the sulphuric acid content to be the same. Yet, here is where the average plater makes his mistake. The Cr. O_3 is a solid or dry measure, and the H_2 SO_4 is a liquid measure, and while he weighs the one, he invariably measures the other. Right here is the rub. Adding .5 oz. of H_2 SO_4 in volume is equivalent to .92 oz. of sulphuric acid by weight. This, as we know, is above the required quantity necessary for successful performance of the bath, and this excess of SO_4 Ion is the detrimental factor. The following table will readily explain the difference in form and weight:

Oz. by Volume	H_2 SO_4	Oz. by Weight
1	=	1.84
2	=	3.68
3	=	5.52
4	=	7.36
5		9.20
6		11.04
7		12.88
8		14.72
9		16.56

And so on.

Unfortunately, there seems to be no simple method of analysis. Probably the most comprehensive data is contained in the Technologic paper No. 346 by Harring & Barrows. Here will be found a description for complete analysis of chromium plating baths.

While the presence of a small amount of the SO_4 Ion is necessary, yet I wish to emphasize the fact that an excess of the SO_4 Ion is a detriment, and under certain conditions results in brittle-

ness of deposit peeling or raising. To overcome this excess of sulphate, we must resort to the addition of certain chemicals which have the property of removing the excess SO_4 Ion without bringing into the solution some other Ion which is not wanted, such a chemical would be Barium Carbonate, or better yet, Barium Chromate. Either of these react with the sulphate Ion and form Barium Sulphate, which is a white insoluble powder, and in case of Barium Carbonate gives off Carbonic Acid gas. While the Barium Chromate gives an equivalent amount of $Cr\ O_3$ acid and Barium Sulphate same as where carbonate is used, in any event it is only necessary to filter off the Barium Sulphate. Approximately two parts of Barium Carbonate will remove one part of the SO_4 Ion. In other words, for every ounce of SO_4 two ounces of Barium Carbonate should be used.

Another problem which the Chromium plater will encounter is the Tri-valent Chromium. As Dr. Lukens pointed out "Tri-valent chromium" (other than Sulphate) which term has been the means of clearing up much of the mystery pertaining to the maintenance of the chromium plating baths. This Tri-valent Chromium is the result of the action of the hydrogen gas liberated at the cathode, causing a reduction of the six valient Chrome to the Tri-valent Chrome. According to the theory the oxygen set free at the anode should oxidize this Tri-valent Chrome back to the hexavalent Chrome, but in practice does not take place only partially. When this Tri-valent Chrome is present in the bath in excess, it results in higher resistance in the bath, and as a consequence it will require a higher voltage to cause a given current to flow through the solution. This would not be so bad if it did not also decrease the throwing power. There seems to be no satisfactory chemical method of disposing of this Tri-valent chemical in the simple matter. Dr. Lukens pointed out that if a small porous cup is suspended in the bath, and within the cup is placed a small lead cathode and the current be passed through the bath from the regular anode through the solution in the cup, the Tri-valent Chromium will be oxidized. While the presence of porous cup prevents the hydrogen from reducing any Chromic acid except that portion which is within the cup, and in this way the effects of the Tri-valent Chromium will be overcome providing the current passed for a sufficient length of time.

You may gather from this that it is well to have the cup handy when the bath is not used for plating purposes, and sus-

pend the cup as described, as any excess use of this will do little or no harm.

Maintenance of Bath

Since all of the metal deposited must come from the Cr. O_3 it follows that additions of this metal from time to time is necessary. There is, however, another factor or problem which must be taken into consideration . That is what is known as the dragout. It has been pointed out by Blume and others that this dragout and spray in terms of Cr. O_3 is approximately equal to the Cr. O_3 used in supplying metal to the article plated. This means then that supposing 1 oz. of Cr. O_3 has been deposited on a given area that the loss by dragout would also be 1 oz. In the case of dragout you would also lose an equivalent amount of the SO_4 Ion. Now, then, in replenishing the metal content of the bath, it would be necessary to replace two ozs. of Cr. O_3 to reimburse the solution for both metal and dragout, but since half of the Cr. O_3 added was dragout, then the corresponding quantity of the SO_4 should be added.

Possibly a simple method of maintaining of solution would be from a stock solution which would contain twice the amount of Cr. O_3 given in the above typical formula. While only the same amount of the sulphate Ion is given in the typical formula, providing, of course, that there is not already an excess of the SO_4 Ion. In that event this excess only Cr. O_3 is needed, and this is one way to overcome excess sulphate in Chromium Baths. The percentage of H_2 SO_4 necessary for successful Chromium deposition is from one-half to 1 per cent of the Chromic Acid used.

"Read at Milwaukee Banquet."

TORONTO BRANCH

Regular monthly meeting of Toronto Branch was held at 22 College St., April 22nd, 1929, Vice President Deakin presiding. The attendance was very good.

We had the pleasure of having Dr. J. T. Burt-Gerrans speak to us. His talk was instructive and he is endeavoring to devote much of his time to the good and welfare of the A. E. S.

Mr. E. G. Lovering of Detroit Branch, who happened to be in Toronto, was a welcome guest at our meeting. Mr. Lovering speaking to us emphasized that a heavy nickel deposit before chromium plating was found to produce a better job. He also assured the members of the splendid program Detroit Branch have in store for the coming convention. He hoped to see all the members there.

W. J. Sutherland, Sec'y-Treas.

NOTICE TO A. E. S. MEMBERS AND THEIR EMPLOYERS

SOME MAN GIVING THE NAME OF ROBERT BLAIR IS SEEKING EMPLOYMENT IN SHOPS GIVING AS REFERENCE: THE STATEMENT HE WAS EMPLOYED AT THE BUREAU OF STANDARDS AT WASHINGTON, D. C., UNDER DR. WM. BLUM. THIS IS NOT SO AND HE IS AN IMPOSTOR AND SHOULD BE APPREHENDED. MEMBERS TAKE NOTICE AND WATCH FOR THIS MASQUERADER. HE IS NOT A PLATER AND GET IN TOUCH WITH THIS OFFICE IF FOUND.

EDITOR.

BALTIMORE-WASHINGTON BRANCH

The regular monthly meeting of the above branch was held April 13th in the Enoch Pratt Library, Calhoun and Hollins St., Baltimore, Md. President F. F. Pierdon presiding.

We had Mr. Taylor of the Hanson Van Winkle-Munning Co. as our speaker, his subject being "Electrical Equipment for Chromium Plating." He stated that the fundamental principles were just the same for chromium plating as for nickel and other solutions. He explained the construction of motors and motor-generator sets, and the advancement being made towards a steady current between anode and cathode. His talk was of special interest to all, and a standing vote of thanks was given Mr. Taylor at the close.

Twenty-five members attended. Meeting closed at 10:30.

Next meeting May 10th. All members requested to attend. Business, "Election of Officers."

Baltimore, Md., May 11, 1929.

Regular meeting of the Baltimore-Washington Branch was held May 11 at the Enoch Pratt Library, Calhoun and Hollins St., Baltimore. President F. F. Pierdon presiding.

The attendance was poor considering the importance of the meeting. And it is to be hoped that all members of this branch will attend the meetings in Baltimore and Washington regularly, and by doing so they will repay our officers for their efforts to make our branch a success.

The educational class will take "Chromium" for the next study.

Future meetings will be held as follows: First Saturday in each month in Baltimore, and last Saturday in each month in Washington.

A special meeting is to be held in Baltimore, June 29th. All members are requested to attend.

Election of officers resulted as follows: President, M. J. Kraft; vice president, T. F. Slattery; secretary-treasurer, G. F. P. Turner; librarian, Dr. Blub; board of managers—F. F. Pierdon, W. M. Gibson,

A. D. Fewell. Delegates to Detroit convention—M. J. Kraft, T. F. Slattery, F. F. Pierdon. Alternates—C. C. Seymoure, A. G. Pierdon.

Geo. F. P. Turner, Sec'y-Treas.

BOSTON BRANCH

Boston Branch held an open meeting on Thursday, May 9, at the American House.

The regular order of business was suspensed with after reinstating one member.

We had with us as the speaker of the evening, Mr. George B. Hogaboom, whose subject was "Question Box on Electro-Plating Problems."

The subject was a very good one and we had a very good man there to answer the some twenty questions that were put to him.

Most of the questions asked were on the chromium solution, such as what is the best formula, and best base metal to plate in the solution, brass, copper, or nickel, and how to control the solution, and if boric acid was better in the solution than carbonate of chromium, can chromium be plated on cadmium efficiently, what makes nickel peel when it is chrome plated and how do you prevent it, how much nickel is required on brass before plating, what is the purpose of boric acid in a nickel solution?

And these are a few of the questions asked Mr. Hogaboom. A rising vote of thanks was given him for his very interesting talk, and hope to have him with us again sometime.

The meeting adjourned at 11 P. M.

A. W. Garrett, Sec'y.

CHICAGO BRANCH

Regular monthly meeting, Chicago Branch, was called to order by President Robt. Meyers at 8:15 P. M., May 11th, at the Atlantic Hotel. The attendance was very good, there being the election of officers, and then our librarian is always on the job to try and have something worthwhile and to keep the meetings interesting. Come out, members, and support Mr. O. E. Servis in his undertakings as you will benefit more than he will.

The convention booster committee reported that everything is shaping up nicely and they expect the largest delegation ever to leave Chicago for the convention. All the committee asks is that the members that go make your reservation early. **Don't forget the date, July 8, 9, 10, 11—Detroit.**

The Grim Reaper again reached into our midst and took unto Himself to the Great Beyond our dear beloved and one of the past presidents of Chicago Branch, Henry H. Posbeck, a member that was at all times ready to assist a fellow member. And again there will be a vacant chair in our meetings. To his widow and family Chicago Branch extend our heartfelt sympathy.

Mr. Frank Novatny, who has been operated upon, is again on the road to recovery and we all wish him well.

May 11th was a great night, it being election of officers, and there

were several good contests. After the smoke of the election cleared away, the tellers found the following officers elected: President, Samuel J. C. Trapp; vice president, J. J. Wittee; secretary-treasurer, John Kretschmer; librarian, O. E. Servis; board of managers, R. J. Hazucha, G. Jelinek, R. Kelley; delegates to convention, F. J. Hanlon, O. E. Servis, Robt. Meyers; alternates to convention, S. J. C. Trapp, H. A. Gilbertson, F. J. Greenwald.

Last, but not least, the honor of the office of sergeant-at-arms fell to our well known member, Mr. David Greenblatt. There is no member of the branch that can fulfill that office as Mr. Greenblatt. Without him there never would be any order. The men respect him, knowing full well that he is short and to the point.

The regular order of business being completed, the librarian conducted the meeting and called upon Mr. Cleveland Nixon, of La Salle, Ill., to give a lecture on corosion of chrome plating. After the lecture it was thrown open to discussion and question, and there were some very interesting remarks made and a great deal of knowledge was obtained. Chicago Branch feel honored to have Mr. Nixon as a member because he is not selfish and will at all times help any member that is in distress. Thanks, Mr. Nixon, and Chicago Branch invites you back at an early date.

After the chromium subject was disposed of the librarian found the following questions in the question box:

Ques. 1. Is it advisable to chrome plate over silver?

Ans. 1. No.

Ques. 2. If a nickel solution register between 5.9-6.1 and the nickel is raised by the chrome around the spots where it has soldered, what is the cause and how can it be prevented?

Ans. 2. Improper cleaning was suggested to scrub soldered parts and plate in cyanide copper before nickeling.

Ques. 3. What causes the formation of a mirror-like scum on the surface of a nickel solution that is not used every day? The solution is well covered when not in use.

Ans. 3. It was thought it was from the tank lining. Do not believe it will do any harm.

Ques. 4. What kind of a tank is best for hot gold solution?

Ans. 4. Ceramic tank.

Ques. 5. What is the best P. H. for a chrome bath in plating brass lamps?

Ans. 5. No answer given.

Ques. 6. What causes brass solution to deposit a very brown color on edges of work?

Ans. 6. Too much zinc or sodium cyanide.

Ques. 7. What is the best P. H. for a hot nickel solution, temperature 110 to 120?

Ans. 7. 5.4-5.6.

Lest we forget, we want to remind you that the annual smoke and installation of officers will be at our next meeting, June 8th. Come and get acquainted with them. Get behind them so as to keep Chicago

Branch out in front. Make your reservation on our Convention Special.

There being no further business, meeting adjourned 10:45 P. M.

S. J. C. Trapp, Sec'y.

CLEVELAND BRANCH

The regular monthly meeting of Cleveland Branch was held at Hotel Cleveland with quite a good attendance. We voted to send a telegram to Mr. Richard H. Sliter, who is ill at the Masonic Home, Burlington, New Jersey, that we had made him a life member of Cleveland Branch with the best wishes of all the boys.

We elected the following officers for the ensuing year: President, Paul R. Stamm; vice president, E. S. Thompson; secretary-treasurer, H. J. Ter Doest; librarian, N. E. Zadowski; board of managers, J. C. Singler, B. F. McCormick, F. G. Cyrex; delegates to convention, E. S. Thompson, J. C. Singler, N. E. Zadowski; alternates, J. C. Mullinnix, L. F. Koehle.

H. J. Ter Doest, Sec'y.

LOS ANGELES BRANCH, A. E. S. (Temporary)

The May meeting of the temporary Los Angeles Branch was held Wednesday, May 8th. Thirty-eight sat down to dinner, after which temporary president, Clarence Thorton, called the meeting to order. After business was disposed of, the meeting was turned over to Charles Russell for educational discussions.

Dr. Chandeysson of St. Louis, Mo., gave a very interesting talk on plating generators, and upon request explained difference between shunt and compound wound motors.

Chas. Westen of Chicago was also a visitor, and congratulated those present on their move to form a branch in Los Angeles. Charlie has the speed cops in Hollywood worried.

John Jacques explained an article in the American Electro Chemical Society Review on the (Beret cathode test for determining ratio of chromic acid to sulphate in chromium plating baths). This was of great interest to all present, and some have already improved their chrome solutions by using this test.

Among the questions in question box was, "How can white metal or brittania metal be silver plated without blistering?"

Chas. Russell gave a good explanation of why metal is hard to clean, and suggested strip composed of 11 ozs. sodium cyanide, 4 ozs. caustic soda, use reverse current, dip in straight muriatic acid, rinse, scratch brush or buff, clean in usual way, rinse, dip in 10 per cent solution muriatic acid, rinse, strike in rich silver strike, then silver plate in regular solution.

Meeting adjourned at 10:00 P. M. At 11:30 P. M. discussions were still in order on several corners of street.

From indications, Los Angeles is going to have a live branch. Any Californian desiring to join this branch, advise M. D. Rynkofs, 1354 W. 25th St., Los Angeles, Calif.

A. E. S. PAGE

Assembled Expert Scraps With and Without Significance

Chicago Branch News:

It is with regret we learn of H. H. Posbeek's death. He was past president of this Branch and one of the *Old Brass Rails.*

Cleveland Branch News:

Just made Past President R. Sliter of Old National Electro Platers Society a life member and ask all members that go through or near Burlington, New Jersey, Masonic home to call on Dick and give him a few minutes of your time. He will be glad to see A. E. S. boys.

Waukegan Chemical Co. subscribers to our Research Fund wish to announce with deep regret the death of Dr. Rudolph Breves, president of their company. Although not a member of A. E. S., he was their friend and had many friends in the society.

S. E. Huenerfauth of Crown Rheostat & Supply Co., has returned from his Florida visit and brought no alligators, snakes or booze with him, so it will be impossible to have him indicted by grand jury.

Chas. Weston of same Company is out golfing with Frank Rushton, at Los Angeles, Calif.

Rudy Hazucha is driving his new Chewtabaker (6) and he was such a good bowler, too.

We are informed that W. S. McKeon of Greencastle, Pa., will oxidize himself into a fly from his town to Detroit Convention. (Some sulphur.) in that airplane we'll say.

Jack Geisman is moving back to Milwaukee, Wis., and will be on the air Tuesday evenings.

Edley, our Mark Twain, e's going tow Hengland. Yes, what!

HARTFORD-CONNECTICUT VALLEY BRANCH

Hartford-Connecticut Valley Branch, A. E. S., held its regular monthly meeting at the Chamber of Commerce room at the corner of Chestnut and Hillman Sts., Springfield, Monday evening, April 22, 1929.

The meeting was called to order at 8:30 p. m. with President Elwin in the chair. There was an attendance of sixteen members. Minutes of the previous meeting were read and accepted. All bills were ordered paid. All correspondence was read and placed on file. The resolution from the Detroit Branch, tabled at the last meeting, was discussed.

Plans were completed for our second annual banquet and educational session to be held at the Hotel Bond, Hartford, Conn., on May 11th. A fine list of speakers have been secured for the educational session, so it is hoped that we shall have a record crowd.

Many of the members who attended the meeting in Newark talked about the fine meeting they had. Among our members whose version of the meeting was very interesting was W. J. R. Kennedy.

The meeting was adjourned at 10:45 p. m. V. E. Grant, Sec'y.

DETROIT BRANCH

The Detroit Branch held its regular monthly meeting April 5th at the Hotel Statler, President E. V. Allen presiding.

The meeting was well attended. Members are very enthusiastic in regard to the coming convention and we promise brother members that their attendance at this event will be well worth their while as Detroit has many surprises to offer.

Our watchword—YOU SEE IT IN DETROIT.

Chas. M. Phillips, Sec'y-Treas.

PHILADELPHIA BRANCH

Regular monthly meeting of Philadelphia Branch was held Friday, May 3rd, at the University of Pennsylvania.

The meeting was called to order by President Gehling, with a large attendance, as the election of officers was the main business of the evening.

After eight years' continuous service we regret to have Mr. Gehling decline a renomination for president, owing to pressure of business. While Mr. Gehling will not hold office, he will give all the time he can to the interest of the branch. As he has been a hard worker for the branch and the society in general, we regret very much to lose him as the presiding officer.

The following candidates were elected for the coming fiscal year: President, Willard M. Scott; vice president, S. T. Lunbeck; secretary-treasurer, Philip Uhl; librarian, A. Hirsch; board of managers, Wm. P. Scott, J. Underwood, H. Snyder; delegates, G. Gehling, P. Uhl, S. T. Lunbeck; alternates, P. Kurzeknabe, W. M. Bennato, A. J. Shaffer.

Mr. Hirsch read the report of the research conference held in Newark, N. J., which was well covered and appreciated.

The final report of the educational committee was read in which they report the meeting having been interesting, and thanked the members for the co-operation in this work and suggested plans to put the chemistry classes on a higher standard.

This being Question Night, various questions were asked and answered by Mr. Scott and members present. Phil Uhl, Sec'y.

PAPER AND DISCUSSION ON "BRIGHT PLATING ON SMALL LEAD PARTS"

By Mr. Joseph Underwood, Read at Philadelphia Branch on April 5, 1929*

MR. JOSEPH UNDERWOOD: My talk will not be very long. I've got some samples here you can pass around and look over.

The plating of copper to bring it from the tank with a brilliant lustre is not difficult nor is there anything secret about it as it has been done for years and by many old-time platers and although I am somewhat of an amateur at it I will try to give to you an idea of how it is done. Any of the formula for copper plating solutions can be used, but the amount of chemicals should be cut to one-half as this solution is operated hot and builds up rapidly in carbonates and although I believe they are beneficial in this type of solution, too high a concentration gives too much resistence in the bath and makes it difficult to control. We prefer to build the solution in the following manner:

1 Gallon Water
3 Oz. Sodium Cyanide
¼ Oz. Rochelle Salts

Heat to about 110 degrees F., then add copper cyanide until a light copper deposit is obtained, then heat to 160 degrees F., and add the brightner, made as follows:

Lead Acetate—4 oz.
Caustic Soda—4 oz.
Water—1 qt.

Lead in any form can be used in place of the lead acetate. Add one pint of brightner and the solution is ready to use.

The Rochelle Salts are added for throwing power and to keep the anodes clean.

At the temperature of 160 degrees F. the work must be cleaned before plating, but the solution is much easier to control at the lower temperature. To use as a combination cleaning and plating bath the solution must be worked at or near the boiling point and although the lustre is more brilliant at the high temperature the solution is made more difficult to control, but if lustre is the main object as with us, the extra trouble is well worth while.

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*Quaker City Reminder.

I will outline the operation on the samples as they are finished by us. They are first racked from 48 to 98 pieces to a rack, the part to be bright faced down to the bottom of the tank. This is done so as to clean more readily and to prevent the inert materials in the tank from settling on the surface. The tanks are equipped with automatic agitators, volt meter, ampmeter and a double throw switch, one side direct to the line and the other to a rheostat. The rack of work is placed three racks to a rod, one rod to each tank. They are then plated for three minutes, direct on the line at a current pressure of 8 volts to remove the lubrication, which is an emulsion of Palm Oil and soap. When the cathode is perfectly clean and completely covered with copper then the rod is agitated for two or three minutes at 8 volts. The switch is then thrown over to the rheostat side and the voltage cut to two or three volts and allowed to run for two or three minutes, or until clear and bright; then it is taken out, rinsed in cold water and placed in the nickel tank. The free cyanide in this type of solution is very difficult to control by analysis and we have never been able to keep any free cyanide in the solution when working at the high temperature, although at the lower temperature it can be readily determined, but by observation it is very easy to control as an excess of Sodium Cyanide causes the cathode to burn around the edges and the center has practically no deposit, while an excess of brightner causes a gray lead tone to the work and is overcome by adding small quantities of copper cyanide. While an excess of copper will cause the deposit to be rough and dull and is overcome by adding cyanide in small amounts, say, two or four ounces at a time, until the deposit comes bright once more. If too much brightner is added, then the solution must be reduced and rebuilt by using copper cyanide and sodium cyanide.

Although our work is only antimonial lead and tin, other types of work can be plated in this type of solution, such as novelties, cheap jewelry, etc., and the saving in buffing and coloring operations is considerable. I have plated die castings and after eighteen months' exposure in the air, although protected from the rain and snow, they showed no signs of breaking down; outside of being dull, they were as good as the day they were plated.

Nickel Plating

The nickel solution when first made up was as follows:

Single Nickel Salts—16 oz.
Epsom Salts—16 oz.
Ammonium Chloride—2 oz.
Boric Acid—2 oz.
Cadmium Chloride as a brightner.

We found that this type of solution for our work was too soft and as we wished to stiffen the parts we gradually built the sloution up until now it stands according to an analysis made two days ago—

Nickel Sulphate—32 oz.

Magnesium Sulphate—26 oz.
Ammonium Chloride—2 1-10 oz.
P. H.—6.1.

and we are obtaining very good results, but we also have one tank kept as the original formula calls for to do certain parts such as a skirt flange that has to be bent under the lip of the bottle. I have plated work in this solution from five minutes to an hour and the lustre was just as bright at the end of the hour as it was at the end of five minutes, but care must be taken not to add too much cadmium chloride, as it will cause dark smuts and seems to cut the throwing power of the solution, and we find that to overcome too much brightner, Magnesium Sulphate and Nickel Salts must be added. We make our own brightner by dissolving Cadmium sticks in Hydrochloric Acid and add 50 cc to every 100 gallons of solution as needed. These nickel solutions are controlled by analysis, made once a week.

All parts are brass plated before gold plating. The brass solution is run at a temperature of 110 degrees F., and is made in the following way:

Four ounces of Sodium Cyanide to each gallon of water; add copper cyanide until a light copper plates out, then add ½ ounce zinc cyanide, then two quarts of ammonia for every 100 gallons of solution, and a green brass deposit is obtained. Then the few drops of brightner made from 4 ounces powdered white arsenic, four ounces caustic soda, dissolved in one quart hot water is then added.

Care must be taken not to add too much as grayish tones will result and it is almost impossible to overcome in this type of solution. A small amount of caustic soda from 1-16 oz. is added about once a week to help keep the anodes clean.

The parts are plated in this solution for two or three minutes, rinsed and flashed in the gold solution, which is made as follows:

Six ounces Sodium Cyanide, ¾ ounce Gold Cyanide; temperature of 170 to 180 degrees F. for about 45 seconds, or according to the amount of deposit needed. The parts are continually agitated while in the gold solution. They are then rinsed in a water tank lined with sheet zinc, which is scraped every three or four days to obtain the gold which deposits on the zinc in the form of a black powder. They are next rinsed in running water and dried in a centrifugal dryer.

ROCHESTER BRANCH

On Friday evening, April 19th, Rochester Branch held their monthly meeting. President Reama was in the chair. A report of the banquet committee was reported and they were discharged with a rising vote of thanks. Five applications were voted on and elected members of Rochester Branch.

Mr. Hart made a motion, seconded by Mr. Gartland, that we have a bowling party May 4th. Carried. President Reama named the fol-

lowing committee: Mr. Wm. Hart, S. P. Gartland, Frank Mesek. After the business meeting gold solutions was the educational feature and the question was, can a gold solution be run daily without any addition of gold in any form in the solution such as gold chloride or trisalyt, the only thing added to the solution being cyanide, all the gold being taken from the anode. After a long discussion it was the opinion of many that if the anode surface was very large the only addition required would be cyanide.

On Saturday evening, May 4th, Rochester members enjoyed a bowling party and buffet lunch at Forester's Hall. There was a good attendance and all had an enjoyable evening. Mr. Gartland and Mr. Reama were captains of the teams. I am not sure who was the winner, but special mention is made of the bowling of Wm. Hart and Chas. Puffer. The match game between Harry Bernard and Adolph Wahl was won by Mr. Bernard.

The committee should have power to have more of these parties as they worked hard and deserve much credit for its success.

Chas. Griffin, Sec'y.

ST. LOUIS BRANCH

Regular meeting of the St. Louis Branch, A. E. S., was held Friday, May 10th, at Central Y. M. C. A.

After dinner meeting was called to order by President Flannery.

After roll call of officers minutes of previous meeting were read and approved.

After report of committees, election of officers for the coming year were as follows: Al. Reifling, president; R. C. Kells, vice president; C. T. McGinley, secretary-treasurer; H. Seimers, librarian; board of managers, F. P. Meninges, F. Horath, J. Sax; delegates to convention, H. H. Williams, C. J. Musick, Ed. Heil; alternate, J. Sax, C. McGinley, F. N. Weber.

Meeting was turned over to librarian, who asked for questions. Questions were asked and after a lengthy discussion, were answered satisfactorily. He then called on Dr. Stout, who gave a simple demonstration on how to determine the sulphate content in a chromium solution, which was greatly enjoyed by all.

Dr. Stout was given a rising vote of thanks for his work for the past year.

A motion was then made to wish our old friend, H. J. Richards, bon voyage across the pond. He will sail May 15th for a visit with his sister and brother in England. While all the members of the St. Louis Branch were not present, we know that they, too, wish him a pleasant trip.

Mr. Richards will be missed by the St. Louis Branch.

Mr. Richards made respond by saying he could not say he was going home as his home was in U. S. A., but while making the trip he would be here in spirit and would be glad to get back with all the members again.

C. T. McGinley, Secretary.

ELECTIONS

	Branch
Howard Marie, 121 Kendall Rd, Oaklyn, N. J.	Philadelphia
Andrew M. Moore, 2701 Fairmont Ave., Atlantic City, N. J.	Philadelphia
Theodore Swanson, 737 Harding Ave., Jamestown, N. Y.	Rochester
Silbert Johnson, 176 Hotchkiss St., Jamestown, N. Y.	Rochester
Wm. G. Price, 317 Lansing St., Utica, N. Y.	Rochester
John H. Pietras, 20 Klaus St., Buffalo, N. Y.	Rochester
Joseph Ruff, 159 Woodlawn Ave., Buffalo, N. Y.	Rochester
T. Curtis McKenzie, 6540 Sylvester St., Detroit, Mich., care Industrial Chem. Products Co.	Detroit
Ellsworth T. Candel, 1120 Baldwin St., Waterbury, Conn.	Waterbury
F. H. Duncombe, Newton Conn.	Bridgeport
Nels Beikander, 65 Clifford St.	Prov.-Attleboro
Oscar Kuntz, 6569 Barlun Ave., Detroit, Mich	Detroit
Jules H. Rohdy, 13811 Van Dyke Ave., Detroit, Mich	Detroit
Carl Broden, 221 W. 15th St., Traverse City, Mich.	Grand Rapids
Joe Verplank, Zeeland Mich.	Grand Rapids
Chester Dykpuis, R. Route No. 9, Holland, Mich.	Grand Rapids
Joseph Piepe, care Stowell Screw Co., Ltd., Lonqueil, Quebec, Canada	Montreal
J. Albert Lariviere, 4157 Garil St., Montreal, Canada	Montreal
Herman C. Braun, 293 Greenwich Ave., Stamford, Conn.	Bridgeport
Alex Grzycomski, 1405 W. Jackson Blvd., Chicago, Ill.	Chicago

REINSTATEMENTS

	Branch
J. M. Cosgrove	Chicago
John Merigold	Newark

RESIGNATIONS

	Branch
Louis C. Martin	Prov.-Attleboro

DEATHS

	Branch
H. H. Posbeck	Chicago
Alfred Gethro	Prov.-Attleboro

SUSPENSIONS

	Branch
E. L. Tannert	New York
A. Plotsky	New York